

## Pronotal Stripes and Wing Length in *Gerris incurvatus* Drake and Hottes (Hemiptera: Gerridae)<sup>1</sup>

RUSSELL C. BIGGAM AND MOLLY W. STOCK

Department of Plant, Soil, and Entomological Sciences and Department of Forest Resources, University of Idaho, Moscow, Idaho 83843

---

**Abstract.**—The discovery of what appeared to be brachypterous female *Gerris incurvatus* with an atypical pronotal stripe led to a study to determine if the presence or absence of this stripe was linked to season, sex, and/or brachyptery, and if the brachypterous striped individuals might be a hybrid between *G. incurvatus* and *G. buenoi*. Results show that the striped brachypterous form of *G. incurvatus* is a seasonal form of the species found only in mid-summer and not later in the season. However, linkage of the pronotal stripe with either sex or brachyptery is not complete. Electrophoretic comparisons show that brachypterous striped and macropterous unstriped female *G. incurvatus* are conspecific and clearly distinct from *G. buenoi*, not a hybrid.

---

Insects of the family Gerridae, often referred to as water striders, water skippers, pond skaters, or wherrymen, are found on the surfaces of most bodies of fresh water throughout the world with the exception of the polar regions. Gerrids have considerable intraspecific variation in wing length, ranging from apterous, brachypterous to macropterous. Most members of the subfamily Gerrinae are either bivoltine or have short development times that suggest that two generations per year are possible (Calabrese 1978). Some populations exhibit differences in wing length between generations.

Previous studies have suggested that environmental factors such as day length, temperature, and habitat stability affect wing length (Brinkhurst, 1959; Vepsäläinen, 1971a, 1971b). For this reason, wing length has not been widely used as a taxonomic character in the Gerrinae. However, the apparent relationship between certain body markings and wing length has posed a problem in identification of *G. incurvatus* Drake and Hottes and *G. comatus* Drake and Hottes. In recent keys (Polhemus and Chapman, 1979; Stonedahl and Lattin, 1982), *G. incurvatus* is primarily distinguished from the sympatric species *G. buenoi* Kirkaldy by its lack of a silvery or rufous stripe on the anterolateral margins of the pronotum. However, brachypterous females of *G. incurvatus* with a pronotal stripe have been discovered and their identity confirmed in collections from northern Idaho.

A similar problem was encountered by Drake and Hottes (1925) who described *mickeli* as a variety of *G. comatus* from five brachypterous females with a russet-brown anterolateral pronotal stripe. Typical *G. comatus* lack this stripe. The variety was later recorded from Minnesota, Oregon, and Colorado; all specimens were bra-

<sup>1</sup>Published as Idaho Agricultural Experiment Station research paper no. 87764.

Table 1. Number and percentage of adult forms of *Gerris incurvatus* Drake and Hottes collected on five dates at Morton Slough, Bonner County, Idaho. M = macropterous, B = brachypterous

Date	FEMALES			MALES		
	M	B	B w/stripe	M	B	B w/stripe
7/18/84	3 (30%)	7 (70%)	7 (100%)	3 (37%)	5 (63%)	0
8/25/84	7 (100%)	0	0	11 (100%)	0	0
7/20/85	11 (12%)	84 (88%)	67 (80%)	17 (30%)	40 (70%)	0
7/18/87	5 <sup>1</sup> (8%)	55 (92%)	53 (96%)	3 (6%)	49 (94%)	6 (12%)
8/25/87	0	0	0	2 (100%)	0	0

<sup>1</sup>Includes one macropterous female with an anterolateral stripe on the pronotum.

chyperous females (Drake and Harris 1928). These authors suggested that males of this variety, when found, might prove it to be a distinct species. However, to date, no males have been discovered. Drake and Harris (1934) later suggested that *mickeli* be retained as a variety of *comatus*, not a distinct species, but they did not allow for the variety in their key.

The questions addressed by this study were: 1) To what degree is the presence or absence of a pronotal stripe linked to season, sex and/or brachyptery in *G. incurvatus*?; 2) Is what appears to be striped brachypterous *G. incurvatus* actually a hybrid between *G. incurvatus* and *G. buenoi* or simply a seasonal form of *G. incurvatus*?; and 3) What inferences can be made about the taxonomic status of *G. comatus* var. *mickeli*? To help answer these questions we used starch gel electrophoresis, a technique that has proven value as an adjunct to more traditional taxonomic methods for elucidating relationships among closely related and/or morphologically ambiguous or indistinguishable groups.

#### METHODS AND RESULTS

Insects for this study were collected with an aquatic D-net on Morton Slough on the Pend Oreille River in Bonner County, Idaho, during summer 1984, 1985, 1987 (Table 1). Species were identified using keys in Drake and Harris (1934) and Stone-dahl and Lattin (1982). On July 18, 1984, 18 *G. incurvatus* (8 males and 10 females) were collected (along with specimens of the gerrids *G. buenoi* and *Limnoporus notabilis* Drake and Hottes). Seven (70%) of the females were brachypterous and could not be correctly identified using established keys; all possessed an anterolateral stripe not found on the three macropterous females or on the males. A subsequent collection on August 25, 1984, yielded 18 more *G. incurvatus* (11 males and 7 females). All females were macropterous and lacked the pronotal stripe as did the males. No brachypterous females were found. A collection the following year on July 20, 1985, yielded 152 specimens of *G. incurvatus* (57 males and 95 females). Of the 95 females, 84 (88%) were brachypterous. Of these 67 (80%) had the pronotal stripe. Only 17 (20%) lacked the pronotal stripe and fit the standard species description. Additional *G. incurvatus* were collected from the site on July 18, 1987. Of the 60 females collected, 55 (92%) were brachypterous. Of these, 53 (96%) had a pronotal stripe. Only 2 (4%) lacked the pronotal stripe.

*G. buenoi* collected with *G. incurvatus* showed similar changes in wing length with season. July collections of *G. buenoi* contained both micropterous and macropterous forms, while specimens collected in August were all macropterous.

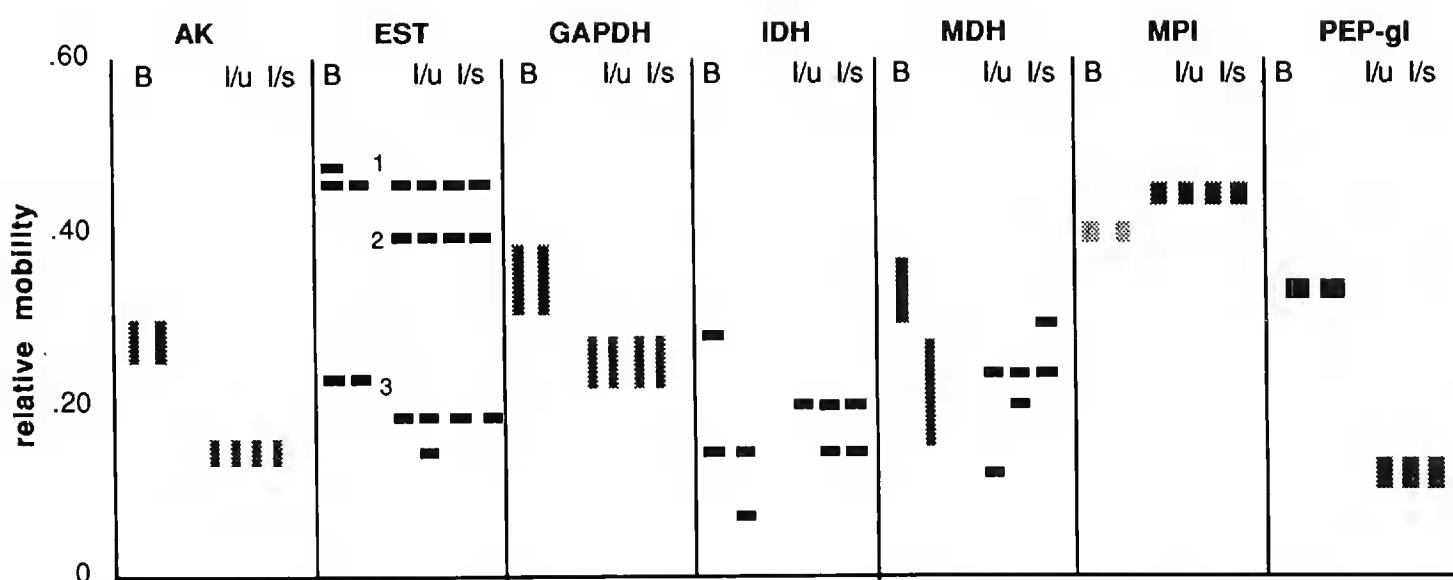


Figure 1. Representative enzyme variations assayed in *G. buenoi* (B), macropterous unstriped *G. incurvatus* (I/u), and brachypterous striped *G. incurvatus* (I/s).

Living specimens from the July 20, 1985, collection were returned alive to the laboratory in an ice chest and then frozen for electrophoretic analysis. Five female specimens of *G. buenoi*, 10 macropterous, stripeless female *G. incurvatus*, and five brachypterous, striped female *G. incurvatus* were subjected to electrophoretic analysis following procedures described by Higby and Stock (1982) and Bentz and Stock (1986). Seven enzyme types were assayed. Of these, assays for esterase (EST), isocitrate dehydrogenase (IDH), malate dehydrogenase (MDH), peptidase (PEP-gl), and phosphomannose isomerase (PMI) followed methods described in the literature cited above. Assays for adenylate kinase (AK) and glyceraldehyde-3-phosphate-dehydrogenase (GAPDH) are those we are currently using for taxonomic studies of *Ips* bark beetles:

**AK:** Aminopropyl morpholine/citric acid buffer system (Clayton and Tretiak 1972), 100 mg ADP, 10 mg NADP (nicotinamide adenine dinucleotide phosphate), 200 mg glucose, 100 units hexokinase, stain mixture (10 mg each nitroblue tetrazolium and MTT tetrazolium, 3 mg phenazine methosulfate, and 1 ml 0.1 M MgCl<sub>2</sub> solution), in 30 ml Ridgway gel buffer (Ridgway et al. 1970).

**GAPDH:** Ridgway buffer system (Ridgway et al. 1970), 10 mg NADP, 35 mg mannose-6-phosphate, 100 units glucose-6-phosphate dehydrogenase, 60 units glucose phosphate isomerase, stain mixture (see AK above), in 35 ml Ridgway gel buffer.

The esterase assays revealed two loci in *G. buenoi* and three loci in *G. incurvatus*. This is not surprising because esterase is highly polymorphic in virtually all insect species that have been tested to date. The six other assays revealed only one locus per gerrid species. At all loci, allozyme banding patterns of brachypterous striped and macropterous stripeless *G. incurvatus* were identical, and banding patterns for insects identified as *G. buenoi* were very different (Fig. 1). No overlap was seen in banding patterns for AK, EST (second and third loci for *G. incurvatus*), GAPDH, MPI, and PEP-gl. Some overlap in banding patterns was seen in IDH and MDH.



## DISCUSSION

The striped, brachypterous form of *G. incurvatus* appears to be a seasonal form of this species. It is found only in mid-summer (July) and is totally replaced by the unstriped, macropterous form by late August. However, not all brachypterous females have the stripe, and even a few brachypterous males and one macropterous female have been observed with the stripe. Thus, although stripes and short wings are more characteristic of females, these features are not invariably linked nor completely sex-linked. The electrophoretic comparisons show that brachypterous striped and macropterous unstriped female *G. incurvatus* are conspecific and clearly distinct from *G. buenoi*, not a hybrid. The totally different electrophoretic patterns seen in these two species at five of the seven loci are clearly diagnostic of complete species separation.

Although a comparative electrophoretic study of *G. comatus* and *G. comatus mickeli* has not yet been performed, it is possible that the brachypterous striped variety of *G. comatus mickeli* is also a conspecific seasonal variant of *G. comatus*. Keys to species of Gerridae should have a qualifying statement added to any couplet using pronotal stripes as the sole distinguishing characteristic for variable taxa such as *G. incurvatus* and *G. comatus*. In addition, features of the male genitalia will usually distinguish taxa that are confused because of intraspecific variation in color patterns and wing length. We also suggest that, when collecting gerrids, a moderate to large series be obtained in the event there is more than one variant form of a species present in the area.

## ACKNOWLEDGMENTS

We thank Dr. Merlyn A. Brusven and Paul E. Blom for help with collections and Sandra J. Gast for help with the electrophoretic analyses. Dr. Gary Stonedahl, American Museum of Natural History, New York, confirmed the identity of the *Gerris* species collected in July 1987. Drs. Gary Stonedahl, Diane Calabrese, William Turner, Merlyn Brusven, and James Johnson provided helpful reviews of the manuscript.

## LITERATURE CITED

- Bentz, B. J. and M. W. Stock. 1986. Phenetic and phylogenetic relationships among ten species of *Dendroctonus* bark beetles (Coleoptera:Scolytidae). *Ann. Entomol. Soc. Am.* 79:527-534.
- Brinkhurst, R. O. 1959. Alary polymorphism in the Gerroidea. *J. Anim. Ecol.* 28:211-230.
- Calabrese, D. M. 1978. Life history data for ten species of waterstriders (Hemiptera: Heteroptera:Gerridae). *Trans. Kansas Acad. Sci.* 81:257-264.
- Drake, C. J. and F. C. Hottes. 1925. Five new species and a new variety of waterstriders from North America (Hemiptera-Gerridae). *Proc. Biol. Soc. Wash.* 38:69-73.
- Drake, C. J. and H. M. Harris. 1928. Concerning some North American waterstriders with descriptions of three new species. *Ohio J. Sci.* 28:269-276.
- Drake, C. J. and H. M. Harris. 1934. The Gerrinae of the Western Hemisphere (Hemiptera). *Ann. Carnegie Museum* 23:179-241.
- Higby, P. K. and M. W. Stock. 1982. Genetic relationships between two sibling species of bark beetle (Coleoptera:Scolytidae), Jeffrey pine beetle and mountain pine beetle, in northern California. *Ann. Entomol. Soc. Am.* 75:668-674.
- Polhemus, J. T. and H. C. Chapman. 1979. Family Gerridae. In: A. S. Menke (ed.), *The Semiaquatic and Aquatic Hemiptera of California* (Heteroptera:Hemiptera), pp. 58-69. *Bull. Calif. Insect Survey*, vol. 21. Berkeley, California: University of California Press.

- Stonedahl, G. M. and J. D. Lattin. 1982. The Gerridae or water striders of Oregon and Washington (Hemiptera:Heteroptera). Tech. Bull. 144, Corvallis: Oregon State University, 36 pp.
- Vepsäläinen, K. 1971a. The roles of photoperiodism and genetic switch in alary polymorphism in *Gerris*. Acta Entomol. Fenn. 28:101–102.
- Vepsäläinen, K. 1971b. The role of gradually changing daylength in determination of wing length, alary dimorphism, and diapause in a *Gerris odontogaster* (Zett.) population in south Finland. Ann. Acad. Sci. Fenn. (A) IV Biologica 183:1–25.